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Clinical paper

Impact of an ICU Liaison Nurse Service on major adverse events in patients recently discharged from ICU☆

Ruth Endacott[a,b,*], Wendy Chaboyer[c], John Edington[d], Lukman Thalib[e,c]

[a] La Trobe University, Bendigo, Australia
[b] University of Plymouth, UK
[c] Research Centre for Clinical and Community Practice Innovation, Griffith University Gold Coast Campus, PMB 50, Gold Coast Mail Centre, QLD 9726, Australia
[d] Intensive Care, Bendigo Health, PO Box 162, Bendigo, VIC 3552, Australia
[e] Faculty of Medicine, University of Kuwait, Kuwait

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ABSTRACT

Aim: To identify the effect of an ICU Liaison Nurse (LN) on major adverse events in patients recently discharged from the ICU.
Methods: Case–control study using a chart audit protocol to assess controls retrospectively and cases prospectively. Controls did not receive ICU-based follow-up care. Cases received at least three visits over 3 days from the ICU LN. The LN service operated 7 days/week 0800–1800. Data on a range of predictors and three major adverse events (unexpected death, surgical procedure needed, and transfer to a higher level of care) were collected using a purpose built audit form.
Results: A total of 388 patients (201 controls and 187 cases) were included in the study. Demographic and clinical characteristics were similar for both groups. A total of 165 major adverse events were identified in 129 patients. After controlling for all other potential predictors, patients who received the LN intervention were 1.82 times more likely to be transferred to a higher level of care ($P = 0.028$) and 2.11 times more likely to require a surgical procedure ($P = 0.006$). Surgical patients were 7.20 times as likely to require a surgical procedure ($P < 0.001$).
Conclusions: Our results support the claim that ICU LN has a role in preventing adverse events. However as the control data was retrospective and the study was conducted at one site, other unknown factors may have influenced the results.

1. Introduction

Patients who have recently been transferred from ICU to a general ward represent a vulnerable group who often have complex care needs[1] which places them 'at risk'[1–3] because general ward staff may not have the knowledge or skills to provide appropriate care.[4–7] Bledon et al.[4] demonstrate that an increased rate of medication errors, lack of care coordination and poor communication between medical and nursing staff occur with more acute patients on the ward, and assert that health system reform must address these problems. Managing high acuity patients on the ward also adversely affects the quantity and quality of care available for less dependent patients.[8]

Recently in Australia the use of an ICU Liaison Nurse (LN) service has emerged to improve the transitional care of patients from the ICU to the ward[9,10]; however little is known about its effect on patient outcomes. To that end, we report on a study that examined the effect of an ICU LN service on major adverse events occurring in patients in the first 3 days after transfer from ICU to the ward.

The major responsibilities of ICU LNs are to facilitate ICU patient discharge, follow up, assessment and support, to manage unstable patients in ward areas and to provide a critical care resource for ward staff. ICU LN services range from 5 to 7 days/week services, with hours ranging from 8 to 24.[11–13] ICU LN services have been shown to decrease ICU discharge delay[14] and improve ICU nurses' perceptions of discharge planning,[9] and have been well received by ward staff.[15] Less is known about their effect on patient outcomes such as cardiac arrests and ICU readmissions, although one recent cohort study did not show that access to an ICU LN service predicted the occurrence of adverse events.[16]

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* Corresponding author at: Faculty of Health, Centre Court, Drake Circus, Plymouth, Devon PL4 8AA, UK. Tel.: +44 1752587488.
E-mail addresses: ruth.endacott@plymouth.ac.uk, r.endacott@latrobe.edu.au (R. Endacott), W.Chaboyer@griffith.edu.au (W. Chaboyer), jedington@bendigohealth.org.au (J. Edington).

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2. Aims of the study

The aim of this study was to identify the effect of an ICU LN service on major adverse events in patients recently discharged from the ICU.

Two research questions were derived from this aim:

1. What is the frequency of major adverse events in two groups of patients, those who receive and do not receive care from the ICU LN service, in the 72 h after discharge from ICU to a medical or surgical ward?
2. What are the predictors of major adverse events in the 72 h after patients are discharged from ICU to a medical or surgical ward?

3. Methods

A case–control study using a chart audit protocol was used to answer the research questions. Controls were reviewed retrospectively and cases prospectively. The study was conducted from January 2005 to January 2006.

4. Sample

This study was set in one regional hospital with 220 beds in Victoria, Australia. All patients discharged from ICU were included in the study if their ICU length of stay was 24 h or longer. Patients were included only once, on their first admission to the ICU, during the study period. Patients who were transferred to other hospitals or discharged directly home were excluded from the study.

5. Intervention

The LN intervention was provided 10 h per day (0800–1800), 7 days a week, similar to ICU LN service provision across Australia at the time of the study.[10,12,13] Each LN was an experienced Registered Nurse with specialist critical care qualification. Additional training was provided to the LNs to standardise the intervention. LNs visited patients at least daily for the first 3 days after ICU discharge. During this visit, they assessed the patient clinically, reviewed their charts, discussed concerns with patients and provided support and informal education to staff caring for these patients.

6. Predictors and outcomes

We used the generally accepted definition of adverse event: "*an unintended injury resulting from health care management, rather than the disease process*".[17] Previous studies have also focused on antecedents of major adverse events[18–20] generally defined as unexpected deaths, cardiac or respiratory arrest, severe respiratory distress and ICU readmission. We examined three major adverse events: unexpected death, transfer to a higher level of care (either high dependency or ICU readmission), and unplanned requirement for surgery. Potential predictors of adverse events that were measured were: age, surgical admission, APACHE II, ICU length of stay (LOS), hours of mechanical ventilation, day of ICU discharge (week day or weekend) and time of ICU discharge (in hours 0800–1800, out of hours 1801–0759).

7. Data collection

A chart audit was used to collect the data. This audit occurred retrospectively for the controls and prospectively for cases. A slightly modified case record form developed in previous studies[16,21] was used by a Research Assistant (RA) to extract chart data. The RA was an experienced Registered Nurse who underwent training in the protocol and who was unaware of the aim of the study. The chart audit protocol involved careful reviewing of the patient's medical records including various flow sheets, medication records, medical and nursing notes. During this review, data was extracted and recorded on a paper case record form. When adverse events were identified, additional supporting secondary information was sought.

8. Data analysis

Descriptive statistics were used to identify the characteristics of the sample and the frequency of major adverse events. *t*-Tests and chi-square tests were used to identify differences between cases and controls in terms of demographic and clinical characteristics. The association between the LN intervention and the incidence of each of the major adverse events was first determined using a univariate logistic regression. Crude odds ratios along with 95% confidence interval and the associated *P* values were calculated. Then, stepwise multiple logistic regression modelling was used to determine which of the potential predictors along with LN intervention, were significantly and independently associated with each major adverse event. Using the stepwise method, only those variables that are significant are retained in the model. Separate models were fitted for each of the major adverse events. Adjusted odds ratios and 95% confidence intervals along with the *P* values are reported.

Ethics approval to conduct the study was obtained from two universities and one hospital. Individual patient consent was waived.

9. Results

A total of 388 patients (201 controls and 187 cases) were included in the study. Demographic and clinical characteristics were similar for both groups (Table 1). Both groups' average age was just under 70 years and included more males than females. Both groups had an average ICU length of stay of less than 4 days and an average hospital stay of 12 days. Just over 20% of both groups were discharged from ICU out of hours or during the weekend.

Table 2 identifies the frequency of adverse events and the effect of the LN on these events using simple (i.e. univariate) logistic regression. A total of 165 major adverse events were identified, 67 in the controls and 98 in the cases, with some patients experiencing more than one adverse event, for example surgical procedure required and transfer to a higher level of care. A total of 129 patients (32%) experienced at least one major event, 52 (25%) controls and 77 (41%) of cases. In this crude analysis, those who received the LN services were 1.88 times more likely to be transferred to a higher level of care than controls and 1.85 times more likely to require a surgical procedure; both of these results reached statistical significance (see Table 2).

Table 3 identifies the independent predictors of major adverse events using stepwise multiple logistic regression. No variables were predictive of unexpected death, therefore this outcome is not displayed in the table. ICU length of stay and timing of ICU discharge were not related to any of the outcome variables that we studied. After controlling for all other potential predictors, patients who received the LN intervention were 1.82 times more likely to be transferred to a higher level of care and 2.11 times more likely to require a surgical procedure, both statistically significant findings. A one point increase in APACHE II score was associated with a 7% increase in the likelihood of requiring a surgical procedure Surgical patients were 7.20 times to require an unplanned surgical procedure, another significant finding.

Table 1
Characteristics of the sample.

Characteristic	Control (retrospective) N = 201 (51.8%) Median (range)	LN intervention (prospective) N = 187 (48.2%) Median (range)	P-Value
Age	69 (19–97)	68 (0–100)	0.720
APACHE II	15 (4–50)	14 (2–41)	0.509
ICU LOS (h)	40 (4–782)	44 (3.8–551.5)	0.378
Hospital LOS (days)	12 (2–212)	12.1 (1.3–98.5)	0.548
Mechanical ventilation (h)	0 (0–726)	0 (0–420)	0.903
Characteristic	**Control (retrospective) N = 201 (51.8%) Freq (%)**	**LN intervention (prospective) N = 187 (48.2%) Freq (%)**	**P-Value**
Male	112 (56.0)	103 (55.7)	0.949
Out of hour D/C (0800–1800)	154 (76.6)	142 (75.9)	0.875
Weekend D/C	40 (19.9)	47 (25.8)	0.167
Surgical patient	141 (70.1)	127 (67.9)	0.634

LOS: length of stay; D/C: discharge.

Table 2
Association between types of major adverse events and the LN intervention quantified by crude odds ratios and 95% confidence intervals obtained using simple logistic regression.

Adverse event	Total sample N = 388 (%) Freq (%)	Control N = 201 (51.8%) Freq (%)	LN intervention N = 187 (48.2%) Freq (%)	Crude odds ratio (95% CI)	P-Value
Transfer to higher care	71 (18.3)	28 (13.9)	43 (23.0)	1.88 (1.14–3.09)	0.014
Surgical procedure required	81 (20.9)	32 (15.9)	49 (26.2)	1.85 (1.09–3.12)	0.022
Unexpected death	13 (3.4)	7 (3.5)	6 (3.2)	0.92 (0.30–2.79)	0.881

Table 3
Independent predictors for each type of adverse events (multiple logistic regression) expressed as adjusted odds ratio (95% CI) and P-value.

Predictor	Transfer to higher level of care	Surgical procedure required
LN intervention	1.82 (1.07–3.09) 0.028	2.11 (1.24–3.58) 0.006
APACHE II	NA	1.07 (1.04–1.11) <0.001
Surgical admission	0.54 (0.32–0.94) 0.028	7.20 (3.21–16.14) <0.001

LN: Liaison Nurse; NA: not applicable as the variable was not retained in the stepwise analysis.

10. Discussion

Just under 400 patients were included in this case–control study of major adverse events after ICU discharge. Cases and controls were similar in all demographic and clinical characteristics.

In this study, 165 major adverse events were experienced by 129 patients, i.e. just under 32% of patients experienced at least one major adverse event. This is higher than a previous Australian study of adverse events after ICU discharge with Chaboyer et al.[16] reporting that 11% of patients experienced a major adverse event in the 3 days after ICU discharge. A number of factors may have influenced our higher rate. First, in the previous study the definition of major adverse events was slightly different to ours and included unexpected death, cardiac/respiratory arrest, and readmission to ICU.[16] Importantly, our current study included requiring surgical procedure as a major adverse event, whereas Chaboyer et al.[16] did not; in our study, 81 patients – 32 (15.9%) controls and 49 (26.2%) cases – experienced this adverse event. A second and important reason that may explain the differences between the two studies is that the current study was undertaken in a regional hospital with fewer and less experienced medical staff.[22]

It is acknowledged that patients discharged from ICU are at risk of deterioration, although precise numbers in this category cannot be estimated.[1] Previous studies report ICU readmission rates between 3.3% and 12%.[23–26] However, our study also included patients transferred to HDU, which may explain the higher rate of transfer. Both controls and cases had more surgical patients (71% and 68%, respectively); this may explain the high number requiring an unplanned surgical procedure.

The relationship between the ICU LN intervention and requiring a surgical procedure and the transfer to a higher level of care were both significant in the multivariate analysis. This suggests that the ICU LN may function as a safety mechanism, identifying the need for an increased level of care. This will inevitably be accompanied by an increase in costs but also likely better outcomes; costs of outreach services such as the ICU LN should also be weighed against costs associated with adverse events.

Our results suggest that there may be a deficiency with the level of vigilance that ward staff can provide. We did not examine this specifically, but previous work has demonstrated that inexperienced nurses and doctors in general wards may not be able to provide the complex care that patients require.[22]

Previous studies have shown that early detection of deterioration and timely interventions are essential to minimise adverse events.[1,18,22,27] Our results suggest that these are improved when an ICU LN service is in place. The presence of highly experienced nurses on the ward cannot be assured[22] and there have been calls for specific training in the discrimination between stable and deteriorating clinical conditions.[18] Our data were collected for 3 days following ICU discharge, which may be a key window during which expertise should be provided for complex patients. The UK clinical guidelines for the management of acutely ill patients[1] also identify the period following discharge from ICU as a point at which the patient is at risk of deterioration. As a minimal level of intervention, it is important to identify who is doing what for patients during this time (when they are most at risk).

APACHE II scores on admission to ICU were a statistically significant predictor of requiring a surgical procedure. This result is difficult to explain. Given that APACHE II includes chronic health evaluation, it may be that patients with high APACHE II on admission were also discharged from ICU with greater co-morbidities.

10.1. Limitations

This study has a number of limitations. First, as controls were retrospective, it is possible that other factors influenced our findings, but as mentioned previously, no major policy or practice changes were identified during the study period. Second, adverse events were identified using chart audits. It is possible that some major adverse events may not have been charted, and therefore not identified in our audit; however this is unlikely given the three major adverse events we studied. Third, while the LNs underwent training and had a clear role description, it is possible that there was variation in the way the role was enacted, which could have an effect on the outcomes. Finally, it is well established that a series of events leads to an adverse event[28]: Reason[29] proposed a '3 bucket' model of error likelihood with factors related to the clinician, the context, and the task likely to increase error. There may be important variables surrounding adverse events that were not measured in this study. Many of these contextual variables would not be suitable for collection from chart audit; however, chart audit remains an important research method to examine adverse events.[30,31]

11. Conclusions

Our results support the role of the ICU LN in preventing adverse events after ICU discharge. However given control data was retrospective and the study was conducted at one site, a number of other unknown factors may have influenced the results. The number of adverse events reported in this study suggests that contextual and organisational factors should be explored further.

Conflict of interest

None.

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References

1. National Institute for Health, Clinical Excellence (NICE). Acutely ill patients in hospital: recognition of and response to acute illness in adults in hospital. Clinical guideline 50. London: NICE; 2007.
2. Durbin C, Kopel R. A case–control study of patients readmitted to an intensive care unit. Crit Care Med 1993;21:1553–7.
3. Walling A. Patient care in the aftermath of discharge from an ICU. Am Fam Physician 2000;61:805.
4. Bledon RJ, Schoen C, Des Roches C, et al. Common concerns amid diverse systems: health care experiences in five countries. Health Affairs 2003;22: 106–21.
5. Chaboyer W, James H, Kendall M. Transitional care after ICU: current trends and future directions. Crit Care Nurs 2005;25, 16-8,20-2,24-6.
6. Whittaker J, Ball C. Discharge from intensive care: a view from the ward. Intern Crit Care Nurs 2000;16:135–53.
7. Clarke T, Abbenbroek B, Hardy L. The impact of a high dependency unit continuing education program on nursing practice and patient outcomes. Aust Crit Care 1996;9:138–59.
8. Coggins RP. Delivery of surgical care in a district general hospital without high dependency unit facilities. Postgrad Med J 2000;76:223–6.
9. Chaboyer W, Foster M, Kendall E, et al. The impact of a liaison nurse on ICU nurses' perceptions of discharge planning. Aust Crit Care 2004;17:25–32.
10. Endacott R, Chaboyer W. The nursing role in ICU outreach; an international exploratory study. Nurs Crit Care 2006;11:94–102.
11. Endacott R, Eliott S, Chaboyer W. The Intensive Care Unit Liaison Nurse role: activities and outcomes. An integrative review. Unpublished report submitted to Department of Human Services, Melbourne; 2008.
12. Barbetti J, Choate K. Intensive care liaison nurse service: implementation at a major metropolitan hospital. Aust Crit Care 2003;16:46–52.
13. Green A, Edmonds L. Bridging the gap between the intensive care unit and general wards—the ICU liaison nurse. Intens Crit Care Nurs 2004;20: 133–43.
14. Chaboyer W, Thalib L, Foster M, Elliott D, Endacott R, Richards B. The impact of an ICU Liaison Nurse on discharge delay in patients who have a prolonged ICU stay. Anaesth Intens Care 2006;34:55–60.
15. Chaboyer W, Gillespie B, Foster M, Kendall M. The impact of an ICU Liaison Nurse; a case study of ward nurses' perceptions. J Clin Nurs 2005;14:766–75.
16. Chaboyer W, Thalib L, Foster M, Ball C, Richards B. Predictors of adverse events in patients after discharge from ICU. Am J Crit Care 2008;17:255–63.
17. Wilson RM, Runciman WB, Gibberd RW, et al. The quality in Australian health care study. Med J Aust 1995;163:458–71.
18. Harrison GA, Jacques TC, Kilborn G, et al. The prevalence of recordings of the signs of critical conditions and emergency responses in hospital wards: the SOCCER study. Resuscitation 2005;65:149–57.
19. Hillman K, Bristow PJ, Chey T, et al. Duration of life-threatening antecedents prior to intensive care admission. Intens Care Med 2002;28:1629–34.
20. Goldhill D, Sumner RJ. Outcome of intensive care patients in a group of British intensive care units. Crit Care Med 1998;26:1337–45.
21. Woloshynowych M, Neale G, Vincent C. Case record review of adverse events: a new approach. Qual Safe Health Care 2003;12:411–5.
22. Endacott R, Kidd T, Chaboyer W, Edington J. Recognition and communication of patient deterioration in a regional hospital: a multi-methods study. Aust Crit Care 2007;20:100–5.
23. Pittard AJ. Out of our reach? Assessing the impact of introducing a critical care outreach service. Anaesthesia 2003;58:882–5.
24. Ball C, Kirkby M, Williams S. Effect of the critical care outreach team on patient survival to discharge from hospital and readmission to critical care: non-randomised population based study. BMJ 2003;327:1015–7.
25. Garcea G, Thomasset S, McClelland L, Leslie A, Berry DP. Impact of a critical care outreach team on critical care readmissions and mortality. Acta Anaesth Scand 2004;48:1096–100.
26. Leary T, Ridley S. Impact of an outreach team on re-admissions to a critical care unit. Anaesthesia 2003;58:328–32.
27. McQuillan P, Pilkington S, Allan A, et al. Confidential inquiry into quality of care before admission to intensive care. BMJ 1998;316:1853–8.
28. Woloshynowych M, Rogers S, Taylor-Adams S, Vincent C. The investigation and analysis of critical incidents and adverse events in healthcare. Health Technol Assess 2005;9:19.
29. Reason J. Beyond the organisational accident: the need for 'error wisdom' on the frontline. Qual Saf Healthcare 2004;13(Suppl. II):ii28–33.
30. Beckman U, Bohringer C, Carless R, et al. Evaluation of two methods for quality improvement in intensive care: facilitated incident monitoring and retrospective medical chart audit. Crit Care Med 2003;31:1006–11.
31. Olsen S, Neale G, Schwab K, et al. Hospital staff should use more than one method to detect adverse events and potential adverse events: incident reporting, pharmacist surveillance and local real-time record review may all have a place. Qual Saf Health Care 2007;16:40–4.